- II - SUBSTITUTE SPECIFICATION under 37 CFR 1.121 (b)(3)

OPTICAL DEVICE Cassandra SPYROU 8/15

FIELD OF THE INVENTION

The invention concernes the space telescopes and large membraneous mirrors.

STATE OF THE FORMER ART

PERKINS and ROHRINGER (US 4 093 351), LE GRILL (Fr 2 662 512), and many other authors describe membranous mirrors tied to a peripheral rigid structure and stiffened and shaped by means of electric charges.

SILVERBERG, (WO 94/10721), describes a double flag membranous mirror, stiffened by surface charges, and shaped by outside fields created by a rigid support.

LENINGRAD PREC MECH OPTI, (SU 1615 655 A) describes a monolithic mirror self shapable made up of two piezoelectric thin plates closely in contact on their whole surface, this mirror being curved overall by a single electrode acting on one of the plates, and locally by discrete electrodes acting on the other plate.

ANDREAS THEODORO AUGOUSTI (GB 2 247 323 A) describes a monolithic mirror self shapable made up of a deformable substrate covered on a face by a reflective surface and on the other face by a network of electrical conductors, the whole being located in a magnetic field with which the currents circulating in the conductors react.

In these two last mirrors the electrodes or conductors in contact with the reflective surface oblige to a high thickness and/or a high rigidity to minimize the surface defects induced by these electrodes or conductors generative of electric and thermal constraints.

None the preceding authors describes or evokes the folding of the mirrors.

HUTCHINSON et all (US Patent N° 5,237,337) describe the folding of a concave metallic membrane on a mandrel, but this folding seems be out of the topological rules.

GOAL OF THE INVENTION

The goal of the invention is to remove the defects of the former art, in particular the necessity of a heavy frame, and the inability to fold purely concave membranous mirror.

SUMMARY OF THE INVENTION

Macro and micro control. The space telescope according to the invention comprises at least a membraneous mirror 1. an actuating membrane 2 for micro shape by mainly electrostatic action the mirror 1, and a magnetic field tied to the telescope for macro shape the actuating membrane 2 by electromagnetic action.

These two levels of shape control allow to avoid the disavantages of ANDREAS THEODORO AUGOUSTI

Parabolic free and without contact membranes.

The mirror 1 and the actuating membrane 2 are free to their peripheries and are tied to the telescope by means of their central parts, either directly or by means of a device.

They do not have material contact between them, exept possible common contact in central part with the telescope

Magnetic dipole for macro control A magnetic dipole centered on the optical axis and tied to the telescope generate a magnetic field axed on this optical axis and interacting with magnetic field of centered or discret coils of the actuating membrane.

BRIEF DESCRIPTION OF THE FIGURES

Fig 1 – Mirror 1 with actuating membrane 2 and magnetic dipoles 3 and 4.

Fig 2 – Actuating membrane 2 with electrodes 5 and 6

Fig 3, 4, 5, 6 - Folding of the mirror.

LIST OF THE ITEMS

1 – Membranous mirror
2 – Actuating membrane
3 – Peripheric coil inducing magnetic field
4 – Central device inducting magnetic field
5 – Circular centered electrode acting upon curvature of the actuating membrane 2
6 – Circular local electrodes having local effet on actuating membrane 2
7 – Conducting surface of the mirror 1
8 – Specific electrodes of the actuating membrane 2 acting the mirror 1

DETAILED DESCRIPTION

I - MIRROR, ACTUATING MEMBRANE, AND MAGNETIC DIPOLES

It is obvious that, when the membranous mirror 1 and the actuating membrane 2 will be unfolded in space, they do not will take back spontaneously their original perfect parabolic shapes

Magnetic field tied to the telescope

Telescope is fitted at its bottom, at the level of the mirror, with device generating magnetic field centered on the axis ot this telescope.

A circular coil made of conducting element, axed on the optical axis of the telescope, when activated by an electric current, generates a magnetic field axed to the axis of the telescope.

The magnetic field can be generated by a coil 3 of diameter egal or biger than the membranes, or by a coil or magnet 4 internal to the central holes of the membranes.

This magnetic field of the dipoles 3 or 4 interacts with the magnetic field genered by electrodes implemented on the actuating membrane, allowing a macro control of the shape of this actuating membrane.

Mirror and actuating membrane.

Surface circular electrodes on actuating membrane. The membrane 2 is locally covered, by means in accordance with the former art, with a number of annular conductive electrodes 5 centered on the optical axis, and a number of local anular conductive electrodes 6.

Actuating coils..

When they are feeded by electric current, discrete coils 5 and 6 of the actuating membrane 2 generate magnetic fields interacting with the magnetic field of the the telescope, so as to

maintain the desired shape of said membrane and to keep it centered on the optical axis of the telescope.

The centered coils 5 generate an axial magnetic field acting on the radius of courvature of the actuating membrane 2, and the local coils 6 generate local magnetic fields having local actions

The actions of coils 5 and 6 give an approximate parabolic shape to the actuating membrane 2 fitted with these coils 5 and 6.

The final perfect parabolic shape is given to the mirror membrane 1 by the electrostatic forces existing between the conducting surface 7 of the mirror membrane and electrodes 8 present on actuating membrane 2.

Macro and micro controls. The system, according to the invention, separates long range action acting on the actuating membrane through the telescope magnetic field interacting with the fields generated by current flowing in electrodes 5 or 6 of the actuating membrane, and short range action acting through electric fields between metallic layer 7 of the membranous mirror and electrodes 8 of the actuating membrane.

Electronic spread in the actuating membrane. Stabilisation of system constituted by mirror 1 and actuating membrane 2. The actuating membrane 2 is locally covered, by means of the former art, with a thin structure identical to that of an integrated multilayer circuit having conducting, insulating or semi conducting elements, contiguous or superimposed.

Electrical supply of these surfaces designs is provided by surface conductors linked to a power supply through the center of the membrane.

These surface designs IC of the actuating membrane 2 allows, according to the invention, through the use of a capacitive coupling between electrodes 8 of the actuating membrane 2 and the metallic layer 7 of the mirror, a self control of the distance between mirror and membrane, and consequently the stabilization of the shape of the membranes without the intervention of a central electronic system.

II - MIRROR AND MEMBRANE FOLDING (Fig.3, 4, 5, 6,). The mirror 1 and the actuating membrane 2 are made totally or in part of a material with shape memory.

After manufacturing, the mirror 1 and the membrane 2 are distorted in such a way that this distorsion is retained until new conditions appear, that brings back the initial shape.

The membranes are concave; if one pushes (Fig. 3) the bottom of the concavity, at its center and perpendicularly to the tangent plane, it results a symmetrical circular distorsion which will intrude into the concavity.

Examination of this previously concave surface then reveals a concave peripheral ring and a central convex surface.

This central convex surface is equally pushed in the same conditions as before, and a new element of concave centered surface can be seen.

Pursuing with the creation of alternately concave and convex surfaces, one obtains a surface resembling a series of circular, centered waves (Fig. 4, 5, 6).

The thickness of this folding, that is the vartical crest to crest distance, can be as small as one wishes. It only requires an increase in the number of waves.

For example, the figure 6 shows a cut in a concave membrane of any diameter, with a great number of waves.

For practical drawing reasons, in particular for scale, the waves are invisible, and this cut is shown by a narrow line, however large is the concave membrane.

Once these waves fixed according to proper physical conditions, the almost flat object so obtained can be wound onto itself, as a flat paper circular disk, allowing an easy transport and an easy launch..

- IV - AMENDED DRAWINGS
Under 37 CFR 1.121 (d)

NEW SHEET 1/2

On immediate anterior figure 1,

a) cancelation of the flanges

b)cancelation of back to back membranes

c) correction of the indices mistakes

Cancelation of the figures 2, 3, 4, 5, 6, 7

Change of indices

Addition in figure 1 of the former coils 72 (see former figure 1) and former dipole 142 (see former figure 43), generating magnetic field

Insertion of the former figure 35 showing the actuating membrane, with active indices.

NEW SHEET 2/2

Addition of a figure 6 showing a cut of a very thin flat folding, in the form of a narrow line.

This very thin folding is the limit of the alternately concave-convex distorsions of a concave membrane.